

REMARKS

This is in full and timely response to the Office Action mailed on February 3, 2009.

Claims 60-61, 73 and 75-99 are present in the above-identified application, with claims 73 and 75 being independent.

No new matter has been added.

Reexamination in light of the following remarks is respectfully requested.

Claim rejections under 35 U.S.C. §112

The Office Action contends that the claims are incomplete for omitting essential steps, such as omission amounting to a gap between steps (Office Action at page 3).

This rejection is traversed at least for the following reasons.

This characterization within the Office Action of the claim language appears to be an attempt to recast the express language found within the claims by redefining the invention in a manner different than from what is set forth within the claims. Moreover:

Claims 54-59, 62-72 and 74 - While not conceding the propriety of the rejections and in order to advance the prosecution of the present application, claims 54-59, 62-72 and 74 have been canceled.

Claims 60-61 - While not conceding the propriety of the rejections and in order to advance the prosecution of the present application, claim 60 has been placed into independent form.

If the allowance of the claims is not forthcoming at the very least and a new grounds of rejection is made at least against either claim 60 or claim 61, then a *new non-final Office Action* is respectfully requested at least for the reasons provided hereinbelow.

Claim 60 is drawn to a surface treatment method comprising:

introducing a supercritical fluid into a treatment chamber, a supercritical substance combined with a co-solvent or reactant becoming said supercritical fluid,

wherein a liquid form of said supercritical substance is absent from within said treatment chamber,

wherein the total amount of addition of said co-solvent or reactant in proportion to said supercritical substance of 40°C and 8 MPa is adjusted within a concentration range from 0.1 to 2 mol %.

Claim 73 - While not conceding the propriety of the rejections and in order to advance the prosecution of the present application, claim 73 has been placed into independent form.

If the allowance of the claims is not forthcoming at the very least and a new grounds of rejection is made at least against claim 73, then a *new non-final Office Action* is respectfully requested at least for the reasons provided hereinbelow.

Claim 73 is drawn to a surface treatment method comprising:

introducing a supercritical fluid into a treatment chamber, a supercritical substance combined with a co-solvent or reactant becoming said supercritical fluid, wherein a liquid form of said supercritical substance is absent from within said treatment chamber;

converting said supercritical substance within said treatment chamber into a gas form, the temperature and pressure of the inner atmosphere of the treatment chamber

being lowered to convert said supercritical substance in said treatment chamber into said gas form.

Figure 5 of the specification as originally filed as provided hereinbelow is a flow chart showing procedures of the surface treatment of the present invention.

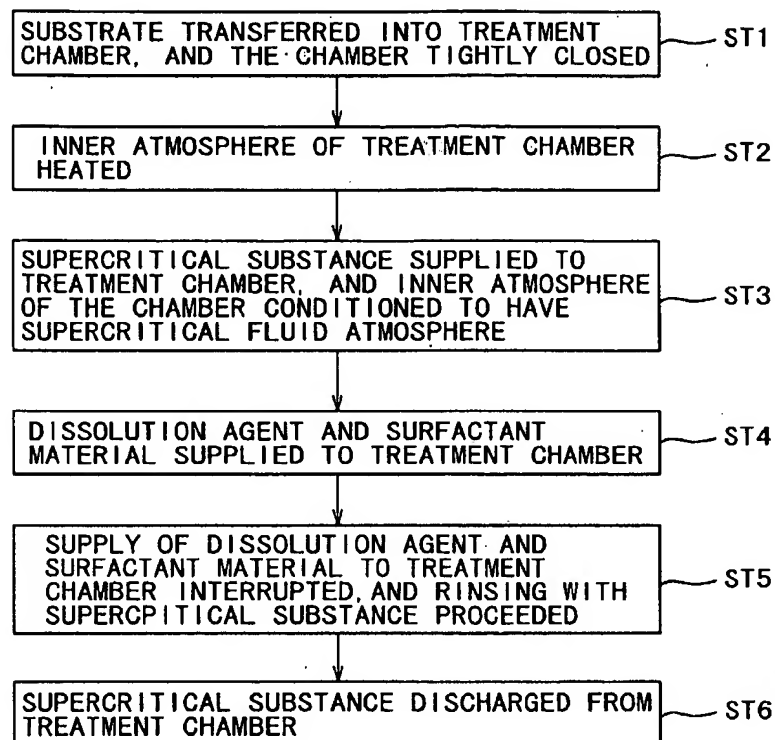


Fig.5

However, the Office Action fails to identify the particular steps that are deemed essential but omitted.

While the Office Action could somewhat possibly be contending that the claim language under consideration may be broad, breadth is not indefiniteness. *Buell v. Beckstrom*, 22 USPQ2d 1128, 1133 (Bd. Pat. App. & Int., 1992.). See also *In re Miller*, 69 USPQ 597, 600 (CCPA 1971) (breadth is not to be equated with indefiniteness).

Here, the claim language is both clear and unambiguous. The attempted reconstruction made within the Office Action is merely an attempt to redefine the invention in a manner different than from what is disclosed within the specification and set forth within the claims. Such an attempted reconstruction is without authority under Title 35 U.S.C., Title 37 C.F.R., the M.P.E.P. and relevant case law; such an attempted reconstruction is therefore deemed improper and inappropriate. See M.P.E.P. §2164.08.

In this regard, the metes and bounds of the claims could be readily obtained by the skilled artisan.

Withdrawal of this rejection is respectfully requested.

Claim rejections under 35 U.S.C. §102 and 35 U.S.C. §103

Paragraph 6 of the Office Action indicates a rejection of claims 54-56, 58-59, 67 and 74 under 35 U.S.C. §102 as allegedly being anticipated by U.S. Patent No. 6,242,165 (Vaartstra).

This rejection is traversed at least for the following reasons.

While not conceding the propriety of the rejections and in order to advance the prosecution of the present application, claims 54-56, 58-59, 67 and 74 have been canceled.

Withdrawal of this rejection is respectfully requested.

Paragraph 7 of the Office Action indicates a rejection of claims 54-55, 57-58, 62-63, 66-67, and 73-74 under 35 U.S.C. §102 as allegedly being anticipated by U.S. Patent No. 6,306,564 (Mullee'564).

This rejection is traversed at least for the following reasons.

Claims 54-55, 57-58, 62-63, 66-67, and 74 - While not conceding the propriety of the rejections and in order to advance the prosecution of the present application, claims 54-55, 57-58 62-63, 66-67 and 74 have been canceled.

Claim 73 - While not conceding the propriety of the rejections and in order to advance the prosecution of the present application, claim 73 has been placed into independent form.

If the allowance of the claims is not forthcoming at the very least and a new grounds of rejection is made at least against claim 73, then a **new non-final Office Action** is respectfully requested at least for the reasons provided hereinbelow.

As noted hereinabove, claim 73 is drawn to a surface treatment method comprising:

introducing a supercritical fluid into a treatment chamber, a supercritical substance combined with a co-solvent or reactant becoming said supercritical fluid, wherein a liquid form of said supercritical substance is absent from within said treatment chamber;

converting said supercritical substance within said treatment chamber into a gas form, the temperature and pressure of the inner atmosphere of the treatment chamber being lowered to convert said supercritical substance in said treatment chamber into said gas form.

Mullee'564 - Mullee'564 arguably discloses that finally, pressure vessel 40 is **depressurized** in step 134 by closing valves 66 and 60 and opening valves 62, 74, 82, 84, and 87 to vent the system to atmosphere (Mullee'564 at column 5, lines 7-9).

Nevertheless, Mullee'564 **fails** to disclose, teach, or suggest the lowering of the temperature of the inner atmosphere of the pressure vessel 40.

But even if Mullee'564 discloses the lowering of the temperature of the inner atmosphere of the pressure vessel 40, Mullee'564 **fails** to disclose, teach, or suggest the **conversion of the supercritical substance within the pressure vessel 40 into a gas**.

- ***Thus, Mullee'564 fails to disclose, teach, or suggest converting said supercritical substance within said treatment chamber into a gas form, the temperature and pressure of the inner atmosphere of the treatment chamber being lowered to convert said supercritical substance in said treatment chamber into said gas form.***

Withdrawal of this rejection and allowance of the claims is respectfully requested.

Paragraph 11 of the Office Action indicates a rejection of claims 68-69, 71 and 72 under 35 U.S.C. §103 as allegedly being unpatentable over U.S. Patent No. 6,242,165 (Vaartstra).

This rejection is traversed at least for the following reasons.

While not conceding the propriety of the rejections and in order to advance the prosecution of the present application, claims 68-69, 71 and 72 have been canceled.

Withdrawal of this rejection is respectfully requested.

Paragraph 12 of the Office Action indicates a rejection of claims 60 and 61 under 35 U.S.C. §103 as allegedly being unpatentable over U.S. Patent No. 6,242,165 (Vaartstra) in view of U.S. Patent No. 6,277,753 (Mullee'753).

This rejection is traversed at least for the following reasons.

Claims 60-61 - While not conceding the propriety of the rejections and in order to advance the prosecution of the present application, claim 60 has been placed into independent form.

If the allowance of the claims is not forthcoming at the very least and a new grounds of rejection is made at least against either claim 60 or claim 61, then a **new non-final Office Action** is respectfully requested at least for the reasons provided hereinbelow.

Claim 60 is drawn to a surface treatment method comprising:

introducing a supercritical fluid into a treatment chamber, a supercritical substance combined with a co-solvent or reactant becoming said supercritical fluid,

wherein a liquid form of said supercritical substance is absent from within said treatment chamber,

wherein the total amount of addition of said co-solvent or reactant in proportion to said supercritical substance of 40°C and 8 MPa is adjusted within a concentration range from 0.1 to 2 mol %.

Vaartstra - Vaartstra, at column 10, lines 6-17, arguably discloses that:

In one preferred embodiment of the present invention, the organic material removal composition includes only sulfur trioxide in its supercritical state. A pressurizable chamber is heated above the critical temperature (218.3°C) of sulfur trioxide, preferably below about 250°C. The chamber is then provided with sulfur trioxide at a pressure above the critical pressure (83.8 atmospheres), preferably below about 100

atmospheres. A preferred desired flow of the sulfur trioxide into the pressure chamber is in the range of about 100 sccm to about 1000 sccm. The organic material is removed during a preferred time range of about 10 seconds to about 60 seconds with a removal rate of about 100 Å/minute to about 1 micron/minute.

Vaartstra, at column 10, lines 18-36, arguably discloses that:

In another preferred embodiment of the present invention, the organic material removal composition includes sulfur trioxide in a nonsupercritical state and carbon dioxide in a supercritical state. A pressurizable chamber is heated above the critical temperature (31°C) of carbon dioxide, preferably below about 50°C. The chamber is then provided with sulfur trioxide and carbon dioxide at a pressure above the critical pressure (72.8 atmospheres) of carbon dioxide, preferably below about 100 atmospheres. A desired flow of the sulfur trioxide into the pressure chamber is in the range of about 10 sccm to about 200 sccm. A desired flow of the carbon dioxide into the pressure chamber is in the range of about 200 sccm to about 1000 sccm. In other words, the ratio of sulfur trioxide:carbon dioxide is in the range of about 1:1 to about 1:100. The organic material is removed during a time period in the range of about 10 seconds to about 60 seconds with a removal rate of about 10 Å/minute to about 1 micron/minute.

➤ However, Vaartstra fails to disclose, teach, or suggest that a liquid form of the carbon dioxide is **absent** from within the pressurizable chamber.

Mullee'753 - Mullee'753, at column 2, line 50, to column 3, line 7, arguably discloses that:

The preferred embodiment of the post-CMP cleaning process of the present invention is illustrated in FIG. 1. The semiconductor wafer including the CMP residue is placed in a pressure chamber in a first process step 20. The pressure chamber is then sealed and pressurized with the carbon dioxide, in a second process step 22. As the

pressure inside the pressure chamber builds, the carbon dioxide becomes liquid and then reaches supercritical temperature and pressure. Typical conditions for this process range from 20 to 70°C and 1050 and 6000 psig. When the desired conditions are reached, a small amount of the chemical is introduced into a supercritical carbon dioxide stream and thus added into the pressure chamber to begin cleaning, in a third process step 24. Typical types and amounts of chemicals are:

- a. 0.1-15.0 v/v % of isopropyl alcohol and related alcohols;
- b. 0.1-15.0 v/v % of propylene carbonate and related carbonates;
- c. 0.1-15.0 v/v % of ethylene glycol and related glycols;
- d. 0.001-5.0 v/v % of ozone;
- e. 0.1-15.0 v/v % of hydrogen fluoride and related fluorides;
- f. 0.1-15.0 v/v % of ammonium hydroxide and related hydroxides;
- g. 0.1-15.0 v/v % of citric acid and related acids; and
- h. 0.1-15.0 v/v % of a mixture of any of the above chemicals.

➤ However, Mullee '753 fails to disclose, teach, or suggest that a liquid form of the carbon dioxide is absent from within the pressure chamber.

Withdrawal of this rejection is respectfully requested.

Paragraph 13 of the Office Action indicates a rejection of claim 70 under 35 U.S.C. §103 as allegedly being unpatentable over U.S. Patent No. 6,242,165 (Vaartstra) in view of U.S. Patent No. 6,306,564 (Mullee'564).

Paragraph 14 of the Office Action indicates a rejection of claims 64, 65 and 68 under 35 U.S.C. §103 as allegedly being unpatentable over U.S. Patent No. 6,306,564 (Mullee'564).

This rejection is traversed at least for the following reasons.

While not conceding the propriety of the rejections and in order to advance the prosecution of the present application, claims 64, 65, 68 and claim 70 have been canceled.

Withdrawal of this rejection is respectfully requested.

Newly added claims

Claims 75-99 - Claims 76-99 are dependent upon claim 75. Claim 75 is drawn to a surface treatment method comprising:

heating a treatment chamber to a chamber temperature prior to introducing a supercritical substance into a treatment chamber, said chamber temperature being equal to or higher than a supercritical temperature of said supercritical substance;

heating said supercritical substance prior to being introduced into said treatment chamber, said supercritical substance being heated to a temperature equal to or higher than said supercritical temperature.

U.S. Patent Application Publication No. 2004/0259357, the publication document for the present application, provides in paragraph [0064] that:

[0064] Therefore, for example, the supercritical substance (e.g., carbon dioxide) supplied in a gas form from the fluid supply source 19, which is kept as being heated to a temperature equal to or higher than the supercritical temperature through adjustment by the pressure/temperature control means 20, is introduced into the treatment chamber 11 initially kept at normal pressure. In this step, similarly to as set in the second step ST2, temperature of the inner atmosphere of the treatment chamber 11 is preliminarily raised to a temperature equal to or higher than the supercritical temperature of the supercritical substance.

U.S. Patent No. 6,242,165 (Vaartstra) - Vaartstra, at column 10, lines 6-17, arguably discloses that:

In one preferred embodiment of the present invention, the organic material removal composition includes only sulfur trioxide in its supercritical state. A pressurizable chamber is heated above the critical temperature (218.3°C) of sulfur trioxide, preferably below about 250°C. The chamber is then provided with sulfur trioxide at a pressure above the critical pressure (83.8 atmospheres), preferably below about 100 atmospheres. A preferred desired flow of the sulfur trioxide into the pressure chamber is in the range of about 100 sccm to about 1000 sccm. The organic material is removed during a preferred time range of about 10 seconds to about 60 seconds with a removal rate of about 100 Å/minute to about 1 micron/minute.

Vaartstra, at column 10, lines 18-36, arguably discloses that:

In another preferred embodiment of the present invention, the organic material removal composition includes sulfur trioxide in a nonsupercritical state and carbon dioxide in a supercritical state. A pressurizable chamber is heated above the critical temperature (31°C) of carbon dioxide, preferably below about 50°C. The chamber is

then provided with sulfur trioxide and carbon dioxide at a pressure above the critical pressure (72.8 atmospheres) of carbon dioxide, preferably below about 100 atmospheres. A desired flow of the sulfur trioxide into the pressure chamber is in the range of about 10 sccm to about 200 sccm. A desired flow of the carbon dioxide into the pressure chamber is in the range of about 200 sccm to about 1000 sccm. In other words, the ratio of sulfur trioxide:carbon dioxide is in the range of about 1:1 to about 1:100. The organic material is removed during a time period in the range of about 10 seconds to about 60 seconds with a removal rate of about 10 Å/minute to about 1 micron/minute.

➤ However, Vaartstra fails to disclose, teach, or suggest heating the organic material removal composition prior to its introduction into pressure vessel 114.

U.S. Patent No. 6,277,753 (Mullee'753) - Mullee'753, at column 2, line 50, to column 3, line 7, arguably discloses that:

The preferred embodiment of the post-CMP cleaning process of the present invention is illustrated in FIG. 1. The semiconductor wafer including the CMP residue is placed in a pressure chamber in a first process step 20. The pressure chamber is then sealed and pressurized with the carbon dioxide, in a second process step 22. As the pressure inside the pressure chamber builds, the carbon dioxide becomes liquid and then reaches supercritical temperature and pressure. Typical conditions for this process range from 20 to 70°C and 1050 and 6000 psig. When the desired conditions are reached, a small amount of the chemical is introduced into a supercritical carbon dioxide stream and thus added into the pressure chamber to begin cleaning, in a third process step 24. Typical types and amounts of chemicals are:

- a. 0.1-15.0 v/v % of isopropyl alcohol and related alcohols;
- b. 0.1-15.0 v/v % of propylene carbonate and related carbonates;

- c. 0.1-15.0 v/v % of ethylene glycol and related glycols;
- d. 0.001-5.0 v/v % of ozone;
- e. 0.1-15.0 v/v % of hydrogen fluoride and related fluorides;
- f. 0.1-15.0 v/v % of ammonium hydroxide and related hydroxides;
- g. 0.1-15.0 v/v % of citric acid and related acids; and
- h. 0.1-15.0 v/v % of a mixture of any of the above chemicals.

➤ *However, Mullee '753 fails to disclose, teach, or suggest heating the carbon dioxide prior to its introduction into the pressure chamber.*

U.S. Patent No. 6,306,564 (Mullee'564) - Mullee'564, at column 2, line 50, to column 3, line 9, arguably discloses that:

FIG. 2 is a schematic diagram of a simplified resist removal system 30 of the present invention, and FIG. 3 is a flow diagram of a simplified resist removal process 32 according to the present invention. With reference to FIGS. 2 and 3, resist removal process 32 is preferably initiated by activating heat exchanger 34 to reduce the temperature of coolant flowing through cold trap 36. Then, system preheating step 38 brings pressure vessel 40, including wafer chamber 42, and solvent chambers 44 and 46 to a preferred operating temperature of 45 to 65°C prior to the arrival of wafer 10. Skilled persons will appreciate that pressure vessel 40 may alternatively be maintained at a preferred processing temperature to facilitate throughput, or the temperature may be gradually increased from ambient temperature after wafer 10 enters pressure vessel 40 to reduce stress on wafer 10 or semiconductor devices or features 22 fabricated on wafer 10. Although electrical resistance heaters are preferably built into the walls of vessel 40 and chambers 44 and 46 to perform

heating step 38, skilled persons will appreciate that other conventionally available heating techniques could be employed. Skilled persons will also appreciate that electrical resistance tape may be wrapped around all or some of the connecting lines, such as line 43 between pump 92 and vessel 40 and lines 45 and 47 between respective chambers 44 and 46 and line 43, to maintain the temperature of parts of system 30 at or near the temperature of vessel 40 and chambers 44 and 46.

Mullee'564, at column 3, line 63, to column 4, line 11, arguably discloses that:

Pressurizing system step 120 involves increasing the pressure of CO₂ in the system to between 2,000 to 6,000 psig, more preferably between 2,500 and 4,500 psig, and most preferably between 3,000 and 3,500 psig by adjusting back pressure valve 112. Other generally preferred conditions for the resist removal process of the present invention range from 10 to 80°C and 750 to 6000 psig, and preferably from 40 to 70°C and 1050 to 4500 psig. When the desired conditions are reached, valve 70 is opened and valve 68 is closed in solvent introduction step 122 to force the CO₂ stream to flow through solvent loop 116 and solvent chamber 44 to introduce a small amount of one or more chemicals into the supercritical CO₂ stream and into pressure vessel 40. The CO₂ flow rate may be reduced to 0.5 LPM, for example, to increase the chemical residence time in pressure vessel 40.

➤ However, Mullee'564 fails to disclose, teach, or suggest heating the carbon dioxide prior to its introduction into the pressure chamber.

Thus, Vaartstra, Mullee'753, and Mullee'564, either individually or as a whole, fail to disclose, teach, or suggest heating said supercritical substance prior to being introduced into said treatment chamber, said supercritical substance being heated to a temperature equal to or higher than said supercritical temperature.

Allowance of the claims is respectfully requested.

Official Notice

There is no concession as to the veracity of Official Notice, if taken in any Office Action.

An affidavit or document should be provided in support of any Official Notice taken. 37 CFR 1.104(d)(2), MPEP § 2144.03. See also, *Ex parte Natale*, 11 USPQ2d 1222, 1227-1228 (Bd. Pat. App. & Int. 1989)(failure to provide any objective evidence to support the challenged use of Official Notice constitutes clear and reversible error).

Extensions of time

Please treat any concurrent or future reply, requiring a petition for an extension of time under 37 C.F.R. §1.136, as incorporating a petition for extension of time for the appropriate length of time.

The Commissioner is hereby authorized to charge all required fees, fees under 37 C.F.R. §1.17, or all required extension of time fees.

Fees-general authorization

The Commissioner is hereby authorized to charge any deficiency in fees filed, asserted to be filed, or which should have been filed herewith (or with any paper hereafter filed in this application by this firm).

If any fee is required or any overpayment made, the Commissioner is hereby authorized to charge the fee or credit the overpayment to Deposit Account # 18-0013.

Conclusion

This response is believed to be a complete response to the Office Action.

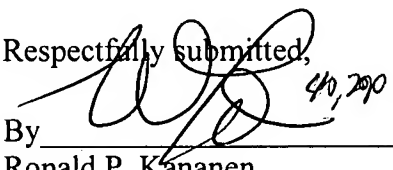
Applicants reserve the right to set forth further arguments supporting the patentability of their claims, including the separate patentability of the dependent claims not explicitly addressed herein, in future papers.

For the foregoing reasons, all the claims now pending in the present application are allowable, and the present application is in condition for allowance.

Accordingly, favorable reexamination and reconsideration of the application in light of the remarks is courteously solicited.

If the Examiner has any comments or suggestions that could place this application in even better form, the Examiner is requested to telephone Brian K. Dutton, Reg. No. 47,255, at 202-955-8753.

Dated: April 17, 2009

Respectfully submitted,

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